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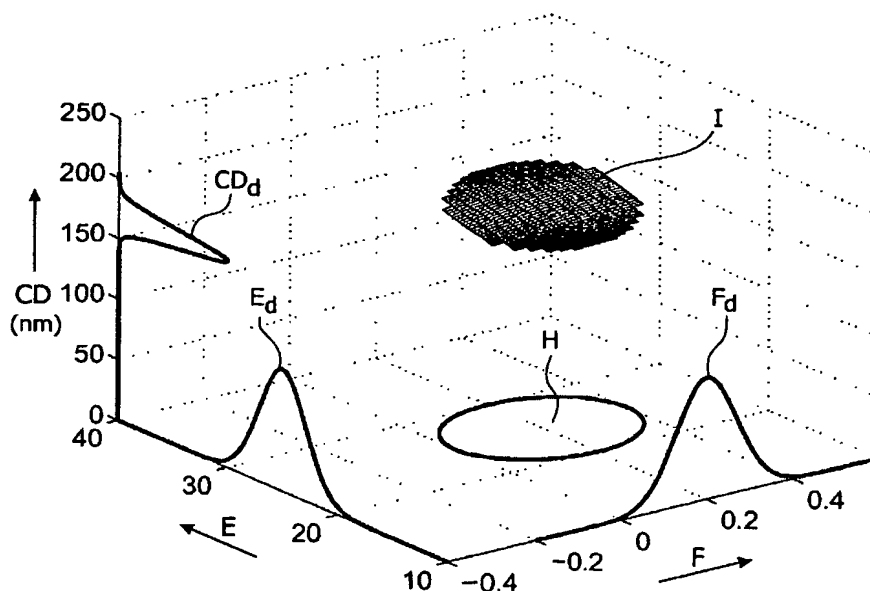
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[Continued on next page]

(54) Title: DETERMINING LITHOGRAPHIC PARAMETERS TO OPTIMISE A PROCESS WINDOW



(57) Abstract: For determining best process variables (E, F, W) setting that provide optimum process window for a lithographic process for printing features having critical dimensions (CD) use is made of an overall performance characterizing parameter (C_{pk}) and of an analytical model, which describes CD data as a function of process parameters, like exposure dose (E) and focus (F). This allows calculating of the average value (μCD) and the variance (σCD) of the statistical CD distribution (CDd) and to determine the highest C_{pk} value and the associated values of process parameters, which values provide the optimum process window.



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Minimum documentation searched (classification system followed by classification symbols)
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2002/085297 A1 (BOWES STEVE W ET AL) 4 July 2002 (2002-07-04) abstract paragraphs '0006!, '0007!, '0009!, '0022!; claims 1,2	1,2,5-11 3,4
X	MANAKLI S ET AL: "Combination multiple focal planes and PSM for sub 120 nm node with KrF lithography: study of the proximity effects" MICROELECTRONIC ENGINEERING, ELSEVIER PUBLISHERS BV., AMSTERDAM, NL, vol. 61-62, July 2002 (2002-07), pages 123-132, XP004360524 ISSN: 0167-9317	1,2,5-11
A	Chapter 3 abstract	3,4

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 01/84382 A (KLA TENCOR INC) 8 November 2001 (2001-11-08) page 2, line 24 - page 3, line 9 page 6, line 35 - page 7, line 6 page 9, lines 25-36 page 10, line 30 - page 11, line 2 page 13, lines 4-12 page 14, lines 23-34; claims 1,2,8,9,27	1,2,5-11 3,4
X A	MACK C A ET AL: "Data Analysis for Photolithography" MICROELECTRONIC ENGINEERING, ELSEVIER PUBLISHERS BV., AMSTERDAM, NL, vol. 46, no. 1-4, May 1999 (1999-05), pages 65-68, XP004170669 ISSN: 0167-9317 page 67, column 2, lines 1-38	1,2,5-11 3,4
P,Y P,A	EP 1 271 246 A (INFINEON TECHNOLOGIES AG) 2 January 2003 (2003-01-02) paragraphs '0007!, '0025!, '0034!; claims 1,2,5-8,11	1,2,5-11 3,4
Y A	US 6 272 392 B1 (CAPODIECI LUIGI) 7 August 2001 (2001-08-07) claims 1,6,7,14,15; figures 4-6	1,2,5-11 3,4
Y A	US 6 478 484 B1 (SINGH BHANWAR) 12 November 2002 (2002-11-12) column 6, line 58 - column 7, line 33; claims 1,2,5,7; figure 3	1,2,5-11 3,4
A	US 2002/131040 A1 (NIU XINHUI ET AL) 19 September 2002 (2002-09-19) claims 1-7	1-11
A	US 5 790 254 A (AUSSCHNITT CHRISTOPHER PERRY) 4 August 1998 (1998-08-04) the whole document	1-11
P,A	WO 03/032381 A (SCHMIDT SEBASTIAN ; MATTIZA DIANA (DE); BROERMANN OLIVER (DE); INFINEO) 17 April 2003 (2003-04-17) claims 1-10	1-11

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 03/06094

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002085297 A1	04-07-2002	US 6545829 B1 US 2002041369 A1	08-04-2003 11-04-2002
WO 0184382 A	08-11-2001	JP 2003532306 T WO 0184382 A1 US 2003148198 A1 US 2004005507 A1 US 2002072001 A1	28-10-2003 08-11-2001 07-08-2003 08-01-2004 13-06-2002
EP 1271246 A	02-01-2003	EP 1271246 A1 TW 550722 B US 2003039905 A1	02-01-2003 01-09-2003 27-02-2003
US 6272392 B1	07-08-2001	NONE	
US 6478484 B1	12-11-2002	NONE	
US 2002131040 A1	19-09-2002	US 2003133104 A1 JP 2002334913 A TW 519746 B	17-07-2003 22-11-2002 01-02-2003
US 5790254 A	04-08-1998	US 5629772 A WO 9849538 A1	13-05-1997 05-11-1998
WO 03032381 A	17-04-2003	DE 10147880 A1 WO 03032381 A2	10-04-2003 17-04-2003